

Specification for the first four of the 15th Class 4-6-4 + 4-6-4 Garratt Locomotives supplied to Rhodesia Railways

Notes to readers

The source document for this file was the Office Copy of the Specification held in the National Railways of Zimbabwe Drawing Office in Bulawayo. It was discovered, in March 1998, while I was helping with searching for a complete set of drawings of the 15th Class locomotives after No. 398 had been purchased by a private group in New Zealand for eventual export to that country.

The original document was a duplicated copy on Foolscap size paper, hence the slightly indistinct type in some places. This was photocopied (with permission) on to A4 size paper while in the Drawing Office and the photocopies scanned when we were back in New Zealand.

The scanned file has been lightly “Photoshopped” to remove most of the artefacts resulting from the photocopying and scanning processes and to increase the contrast to make it more readable.

In several places on the source document there were alterations, amendments and corrections done by hand. These have all been left in place and this file is an accurate reproduction of the original.

All of the pages on the original document were numbered at the bottom. However, in order to ensure that all of the important text was captured when the original was photocopied, it was sometimes not possible to include the page numbers.

Alan Bailey
December 2010

RHODESIA RAILWAYS, LIMITED.
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15th CLASS GARRATT LOCOMOTIVES.

(4-6-4 x 4-6-4)

REVISED SPECIFICATION

July 1939

ENGINEERS - FREEMAN, FOX & PARTNERS,
Broadway Buildings,
Westminster.
LONDON, S.W.1.

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NOTE:- Clauses are numbered consecutively after those in the Engineers' General Specification for Engines and Tenders (1925).

Type.

122. The locomotive is to be of 4-6-4 x 4-6-4 Garratt type, generally in accordance with Diagram No. 5413.

Limiting Dimensions.

123. The locomotive is to be suitable for a rail gauge of 3'6" and curves of 275 feet radius, and is not to exceed the moving structure gauge shown on drawing No. A. 37649. ✓

Conditions of service.

124. The locomotive is required for operating fast passenger trains of 550 short tons between Bulawayo and Kafeking, at speeds on the level not exceeding 50 miles per hour, and on grades of 1 in 80 with 10 chain curves uncompensated, and with short lengths of 1 in 66, at not less than 20 miles per hour. It will also be required to work ordinary goods trains.

Axle load.

125. The maximum axle load with tanks and coal bunker full, the water level in the boiler 3" above the bottom of the gauge glass, 10 cwts. of coal on the grate, brick arch in position, sand boxes full, full equipment of tools, and generally in working order, is not to exceed 13-1/4 tons (29,680 lbs.). ✓

Leading particulars.

126. The leading dimensions, weights and other particulars, are as follows:-

Cylinders.

Number	2 pairs.
Position	Outside.
Diameter	17-1/2 ins.
Stroke	26 ins.

Wheels.

Coupled... ..	diameter...	57 ins.
Inner bogies ...	" ...	33 ins.
Outer " ...	" ...	33 ins.

<u>Wheelbase.</u>		<u>Ft.</u>	<u>ins</u>
Coupled	10.	6	5
Total (each unit)	31.	10-1/4	
Total (engine)	84	3	
Bogie, outer... ..	6.	6	
" inner... ..	5.	2-1/2	

Pivots

Centre to centre... ..	40.	9
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Height.

Rail to centre of boiler... ..	8.	7
" " top of chimney	13.	1
" " centre of coupler	2.	10-1/2

Boiler.

Diameter, outside (smallest ring) .	6.	4-9/16
Length between tube plates	12.	11-7/8

Firebox.

Width, inside	6.	2-7/8
Length, inside	7.	11-1/8

Tubes.

Superheater flue. 38,	5-1/4" dia.	x 3/16" thick
Small 214,	2" "	x 11 S.W.G. "
Brick arch ... 4,	3" "	x 1/4" "

Heating surface.

Superheater flue & small tubes ...	2,126	sq. ft.
Superheater	480	"
Firebox, including arch tubes ...	212	"
Total ...	2,818	"
=====		

Grate area 49.5 sq. ft.

Working pressure 180 lbs. per sq. in.

Axle weights (estimated).

	: In working order.	: With tanks & bunker empty.
	: lb.	: lb.
	=====	=====
<u>Front Unit.</u>		
Outer bogie.	: 53,760	: 36,960
" coupled.	: 29,680	: 20,720
Driving.	: 29,680	: 21,280
Inner coupled.	: 29,680	: 21,280
" bogie.	: 51,296	: 39,200
<u>Hind Unit.</u>		
Inner bogie.	: 52,416	: 39,200
" coupled.	: 29,680	: 21,280
Driving.	: 29,680	: 21,280
Outer coupled.	: 29,680	: 20,720
" bogie.	: 53,760	: 35,840
Total.....	: 389,312	: 277,760

= 173.8 long tons 124.0 long tons.

Adhesive weight
(in working order) ... 178,080 lb. 126,560 lb.

<u>Tractive effort</u> (at 75 % boiler pressure).	37,720 lb.	37,720 lb.
<u>Ratio, Adhesive</u> <u>Weight to Tractive</u> <u>Effort.</u>	4.7	3.35
<u>Fuel capacity.</u>	10 long tons (22,400 lb.) coal.	
<u>Water "</u>		
Front Unit ...	4,300 galls	= 19.2 long tons.
Hind " ...	2,700 "	= 12.1 " "
Total...	7,000 "	= 31.3 " "
=====		

Exhibited drawings.

127. The locomotive is to be constructed in accordance with the undernoted drawings in so far as they are applicable:-

<u>No.</u>	<u>Title.</u>
5413.	Preliminary diagram (enclosed herein).
69/T. 6403/8.	Boiler.
6/9539/7228/18/L. 817.	Crown stays.
69/T. 6403/11.	Waterspace stays.
69/T. 6403/20.	Gusset stays.
69/T. 6403/16.	Superheater elements.
28/T. 9470/26.	Ashpan and arrangement of grate.
28/T. 9470/34.	Smokebox.
5137.	Blast pipe cap.
114964.	Arrangements of cylinders and
5415.	Piston valve. Valve motion.
28/T. 9470/114)	
28/T. 9470/115)	Steam reversing gear.
69/T. 6403/51.	Cowcatcher.
69/T. 6403/62.	Coupled axleboxes.
28/T. 9470/143.	Cab ventilator.

Serial numbers

128. The serial numbers of the engines are to be 271 to 274.

Boiler.

129. The boiler is generally to be identical with those of the 16th Class locomotives, Order No. 69, drawing No. 69/T. 6403/8, subject to the modifications herein specified.

130. The boiler barrel is to be of the parallel type composed of two rings, each being in one plate. The outside diameter of the smaller ring is to be 6ft. 4-9/16ins.

131. The boiler plates are to be of the following thicknesses:-

Barrel plates	11/16" + 1/32".
Firebox wrapper plate ...	9/16".
Firebox back " ...	9/16".
Throat " ...	11/16".

132. The factor of safety of the plates and riveted joints is to be not less than 5.

133. The firebox is to be of the round top type and the outer steel wrapper plate is to taper towards the back plate parallel with the crown of the inner copper wrapper plate, so that all crown stays in any one longitudinal row are of equal length.

134. The inner firebox is to be of copper. The tube plate is to be 1-1/8" thick at the tube area, tapering to 5/8" thick at the foundation ring. The flanges are to be 5/8" thick and the bridges between tube holes should be 15/16". The copper wrapper plate and back plate are to be 1/2" thick.

135. The smokebox tube plate and firebox steel back plate are to be stayed by means of gusset plates as on drawing 69/T.6403/20.

136. The inner and outer firebox plates are to be stayed together with copper stays, screwed 11 threads per inch. 128 flexible stays, of the type shown on drawing 69/T.6403/11, made of DUNIC steel are to be fitted in the top front and back corners of the firebox, as arranged on drawing 69/T.6403/8.

137. The crown stays are to be of DUNIC or S.D.S. steel (United Steel Companies, Ltd.). Nuts of Brown, Bayley's Bresrley C steel are to be used on the fire side. These nuts are to be provided with a spigot 1/16" deep, and are to extend 1/16" beyond the screwed ends of the stays. Nuts on the water side are to be provided.

138. The crown stays are to follow generally the design on drawing 6/9539/7228/18/L.817.

139. The water spaces are to be 3-1/2" at the foundation ring at sides and back, and 4" at the front.

140. Longitudinal stays are not required.

141. The tubes are to be of AQUACIDOX brand corrosion resisting steel. The 38 superheater flue tubes are to be 5-1/4" outside diameter x 3/16" thick, reduced to 4-3/16" diameter and 3-11/16" diameter in the firebox tube plate. The 214 small tubes are to be 2" diameter x 11 S.W.G. thick, reduced to 1-7/8" diameter in the firebox tube plate. The tubes are to be expanded in both tube plates and beaded over at the firebox end only. No ferrules are required.

142. Four brick arch support tubes, 3" outside diameter x 1/4" thick, are to be provided in the firebox and are to be expanded into the copper plates and beaded over. Noble ferrules are not required.

143. Seatings for the brick arch tube plugs are required on the back plate only, the plugs on the throat plate being screwed directly into the plate. The seatings and plugs are to be in accordance with drawing 5331, Items A and B.

144. Provision is to be made for two steam turrets outside the cab, and an internal steam pipe is to be led from the dome to the turrets. A drain hole in the underside of the steam pipe is not required.

145. The boiler is to be supported at the front end on a cast steel two section saddle.

146. The firebox is to be supported at the sides by two expansion angle irons, riveted to the firebox wrapper plate and supported by the boiler frame on suitable bronze slides.

147. The smokebox tube plate is to be 7/8" thick, flanged all round and machined circular, so as to fit accurately inside the barrel.

Ashpan and firegrate

148. The ashpan is to be of similar design to the S.A.R. G.M. Class, with large lifting sliding doors at the sides and without end doors.

149. The ashpan is to be attached to the boiler frame and air spaces are to be provided close to the foundation ring along the sides.

150. An ashpan drench is to be arranged with holes not less than 1/4" diameter, spaced 1-1/2" apart.

Separate jets are not required. The water pipes are to have a removable plug at the front end to facilitate cleaning. At the hind end the pipes are to be coupled by suitable copper piping to the control valves on the injectors.

151. A rocking grate and drop grate of similar design to drawings 4153, 28/T.9470/29 and 30 are to be provided. The finger bars are to be operated by steam power and also by levers situated in the cab. The drop grate is to be operated by a lever. The operating levers are to be clearly marked by means of small brass plates and locked by suitable clips.

Brick arch.

152. The brick arch is to be composed of standard firebricks to drawings 2087, 3614 and 4214, in accordance with the table given on drawing 3991.

Superheater.

153. The superheater header and elements are to be of the Superheater Co.'s M.L.S. type with ball and socket joints and with anti-vacuum valve in the header. The elements are to be fitted with the improved element clamp, washers and element bolts. The elements are to be 1-3/8" outside diameter and identical with those shown on drawing 69/T.6403/16. The superheater header of each engine is to be provided with a boss drilled, tapped and plugged for the accommodation of a pyrometer.

Smokebox.

154. The smokebox is to be generally in accordance with drawing 28/T.9470/34, the plate# for the ~~front end~~ wrapper being 3/8" thick. These plates are to be clean, and ground smooth all over.

155. The front plate is to be 5/8" thick and is to be secured by 5/8" bolts to a 2-1/2" x 2-1/2" x 3/8" angle ring, riveted to the wrapper plate. The bolts securing the front plate are to have the nuts on the outside of the smokebox and the ends of the bolts are to project slightly through the nuts.

156. All rivet holes in the smokebox wrapper plate are to be countersunk on the outside and the rivets ground off flush with the outer surface of the plate.

157. The wrapper is to be formed in one plate, the joint being about 11-1/2" from the bottom centre line and welded to form a butt joint.

158. The wrapper plate is to be secured to a ring 1-1/2" thick x 2-1/2" wide fitted to the outside of the first course of the barrel, the wrapper plate, ring and barrel plate being riveted together with a single row of 3/4" rivets.

159. The smokebox door is to be identical with that shown on drawing 28/T.9470/34 and secured by dogs.

160. The chimney is to be of the type shown on drawing 28/T.9470/35. The chimney base is to be machined and secured to the smokebox by 5/8" bolts with open ended nuts on the inside. Smoke screens are not required.

161. A cast iron petticoat is to be attached to the bottom of the chimney inside the smokebox.

162. A liner plate, 5/16" thick, is to be riveted to the bottom of the wrapper plate inside the smokebox.

163. The smokebox main steam pipes are to be of weldless steel and arranged as on drawing 28/T.9470/34, so that the side superheater elements can be withdrawn without dismantling the steam pipes.

164. The smokebox steam pipes are to be 5" internal diameter and provided with the lens joint ring, as shown on drawing 49/T.1306/36/L.863.

165. The blast pipe is to be of cast iron surmounted by a bronze cap containing the blower ring and vacuum ejector exhaust, similar to that shown on drawing 5137, the diameter of the orifice being suitable for the four 17-1/2" x 25" cylinders.

166. The blast pipe cap is to be provided with Goodfellow tips.

167. The exhaust pipe joint ring is to be similar to Item C, drawing 28/T.9470/37, and made in two pieces fastened together with two brass clips, as Item D of the same drawing.

168. All pipe connections are to be of the cone type, conforming to Rhodesia Railways Standards, drawings S.O.229A to 234 inclusive.

169. The spark arrester is to be in accordance with drawing 28/T.9470/38.

170. An ash ejector to drawing 69/T.6403/15 is to be provided.

171. The standard Rhodesia Railways monogram plate in brass, to drawing 28/T.9470/179, is to be fitted to the smokebox on each side of the engine and a brass register plate, with the number of the boiler stamped on, is to be placed on the horizontal centre line of the smokebox as nearly as possible under the centre of the chimney. The boilers are to be numbered 344 to 347.

Washout and inspection plugs.

172. The washout and inspection plug seatings are to be of steel, thoroughly bedded and riveted to the plates, and in addition, lightly welded in the angle formed by the junction of the flange with the plate.

173. The seatings at the firebox corners are to be in accordance with drawing 69/T.6403/9.

174. Inspection and washout seatings are to be fitted on the sides of the firebox steel wrapper plate in line with the crown of the copper firebox.

175. Seven washout plugs are to be provided in the smokebox tube plate, as shown on drawing 28/T.9470/34.

176. Ten washout plugs are to be provided at the front end of the barrel and suitably arranged to facilitate the cleaning of the gusset stays and tubes. The two top plugs are to be screwed into seatings, and the remainder into the barrel plate.

177. The washout plugs for cleaning the gusset stays at the firebox backplate are to be arranged as on drawing 69/T.6403/20.

178. The washout plugs are to be to Rhodesia Railways Standard taper of 1 in 8 screwed 11 threads per inch, to drawing 3827.

Fusible plugs.

179. Two fusible plugs to drawing 3710 are to be fitted in the crown of the inner firebox, one at the front and one at the back as shown on drawing 69/T.6403/8.

Internal main steam pipe.

180. The main steam pipe is to be of copper, 6-3/4" internal diameter and 5/16" thick.

Boiler mountings.

181. All boiler mountings are to be made of gun metal and finished bright. All cocks are to be asbestos packed. The spindles of valves used for the supply of steam to auxiliaries are to be made of Dixtrudo or other similar quality metal.

Safety valves.

182. Three standard 3" ROSS safety valves are to be mounted on the top of the firebox and set to blow off at 180-lb. per sq. inch.

Steam turrets.

183. Two steam turrets, similar to S.A.R. 23 Class, to supply steam to all auxiliaries, except the pressure gauge, are to be provided outside the cab, one on each side of the centre line of the boiler.

184. The left-hand turret is to be fitted with steam valves for the following fittings, reading from left to right:- injector, L.H., lubricators, blower, dynamo tube cleaner, steam firedoor. The right-hand turret is to be fitted with steam valves for the following fittings, reading from right to left:- injector, R.H., ejector, steam reverse, steam heating, grate shaker, spars.

185. A master valve to shut off steam from all mountings is to be provided on each turret.

186. The spindles from the steam valves are to project into the cab through a suitable brass plate, curved to the radius of the boiler, with the name of each fitting clearly cast on. Each spindle is to be fitted with a cast or pressed bronze wheel.

Pressure gauge cock.

187. The pressure gauge is to be supplied with an independent cock to drawing 49/T.1306/47A/L.558.

Feed water heater.

188. A Gresham & Craven 2" combined feed water heater and clack boxes in one mounting is to be fitted on the top of the boiler, between the dome and smokebox and catchment trays of S.A.R. type are to be provided in the boiler barrel and arranged as shown on drawing 116371.

Blower.

189. The blower valve on the left-hand turret is to be the S.A.R. standard type and connected by an external copper pipe to the elbow, Item J, drawing 6/9539/7228/77/L.817, situated on the left-hand side of the smokebox. A separate copper pipe is to connect the elbow to the blast pipe cap, drawing 5137. The cones, nuts and unions for the external pipes are to be in accordance with Rhodesia Railways Standards.

Whistle.

190. One whistle and whistle cock are to be placed in a vertical position on the safety valve stand, in accordance with drawing 6/9539/7228/74A/L.817.

Water gauges.

191. The boiler water gauges are to comprise Dewrance Pattern cocks, to drawing 69/T.6403/22, with gauge glass protectors to drawing 3967. The gauges, two in number, are to be arranged so that the crown of the firebox is well covered when the water is just showing at the bottom of the glass and the engine commences to descend a grade of 1 in 80, or stands on a 10 chain curve having a super-elevation of $4\text{-}1/4$ ".

Pressure gauge.

192. The steam pressure gauge is to be in strict accordance with sample No.L.O.258, and fitted with Dewrance's latest pattern movement 1938. The dial is to be calibrated from 0 to 240 lbs. per sq.inch, and marked with a red line at the working pressure of 180 lbs. per sq.inch. A steam chest pressure gauge is to be provided and fixed in close view of the Driver.

Vacuum gauge.

193. The vacuum gauge is to be of the DUPLEX type as shown on drawing 6/9539/7228/84/L.817.

Pyrometer.

194. One engine only is to be provided with a pyrometer, the gauge having a range of 200° to 800° F.

Injector steam valves.

195. The injector steam valves are to be in accordance with drawing 69/T.6403/23, Item L.

Ejector.

196. The ejector is to be Gresham & Cravens' Type S.J., with graduable steam brake valve and release valve.

It is to be attached to a bracket secured to the right-hand side of the firebox back plate in such a manner as to preclude vibration of the ejector while the engine is running.

Ejector exhaust.

197. The ejector is to exhaust into a solid drawn steel pipe, 2-1/2" external diameter, 1/8" thick, carried externally along the boiler from the ejector to the smokebox, where it is to terminate in an expansion joint on an elbow passing through the smokebox wrapper plate. A copper pipe, 2-1/2" external diameter and 10 S.W.G. thick, having suitable flanges is to connect the elbow to the blast pipe cap.

198. Two bosses, each 1-1/8" external diameter, screwed 11 threads per inch for a length of 3/4", and with 1/2" hole, are to be welded to the underside of the ejector exhaust pipe, one near the smokebox elbow and the other in front of and close to the cab. Copper drain pipes are to be attached to the bosses and led inside the boiler frame clear of the axleboxes.

Ejector steam cock.

199 The ejector steam cock is to be the S.A.R. standard type.

Turbo-generator valve.

200. The turbo-generator valve is to be the S.A.R. standard type.

Ashpan drench cock.

201. The ashpan drench cock is to be in accordance with drawing 6/9539/7228/93/L.817, Item R, modified for standard cone joint, cone No.8, drawing S.O.229A, and suitable union nut of the type shown on drawing S.O.232.

Blow-down cock.

202. Two EVERLASTING blow-down cocks, as supplied by Everlasting Valve Co.Ltd., are to be fitted, one on each side of the firebox at the bottom, at the front end. The discharge is to be directed downwards and outwards by means of elbows and piping, and not between the rails, and a muffler of approved design is to be provided on each discharge pipe. The flanges of the blow-off cocks are to be identical with the standard blow-off cock shown on drawing 4130. The blow-off cocks are to be arranged for operation from the cab by means of suitable rods.

Regulator.

203. The regulator, handle and sector are to be in accordance with drawings 69/T.6403/17 and 18, except that the lift of the regulator valve is to be increased by 1/8" to suit the 6-3/4" diameter main internal steam pipe. The regulator stand pipe is to be 6-3/4" internal diameter.

Soot blower.

204. A Clyde Mark VII type soot blower is to be fitted in the centre of the firebox back plate.

Firedoor.

205. An AJAX steam operated firedoor and a firehole protector plate are to be provided, and arranged as shown on drawing 69/T.6403/12. The distance between the tender shovel plate and the fireman's foot pedal is to be approximately the same as on the 16th Class locomotives, Order 69.

Injectors.

206. Two engines are to be fitted with Gresham & Craven No.11 injectors with No.11-1/2 cones, and two engines with Davies & Metcalfe No.11 injectors with No. 11-1/2 cones. The injectors are to be placed one on each side of the footplate. The water ~~and overflow~~ cocks are to have handles extended vertically through the cab floor to a suitable stand, with each hand clearly marked WATER ~~and overflow~~, as shown on drawing 28/T.9470/59.

207. The injector steam pipes being situated outside the cab, it is not necessary for them to be lagged. The injector feed pipes below the platforms may be of weldless steel tube, instead of copper. The steam and feed pipes above the platforms are to be of copper and polished.

Lubricators.

208. Two Wakefield EUREKA type H lubricators, with ^{27.} four feeds, as shown on drawing 69/T.6403/25, with transfer filler and with adaptors for outlet pipes, to Drawing 5414, for each feed to valves and cylinders are to be provided for the lubrication of the cylinders and valves. Particular care is to be paid to the lubricator brackets, to ensure that they are of ample strength and well stayed to prevent vibration of the lubricators when the engine is in motion. Drawing 5354 indicates the method of staying to be employed.

Lubricator oil pipes.

209. The oil pipes are to be of copper and arranged to follow as direct a route as possible without any sags or sharp bends. They are to be fitted with standard unions to drawings S.O.229A, 230A and 232, suitably arranged, so as to avoid the necessity of removing the whole length of pipe in case of leakage or stoppage of the pipe.

210. Each oil pipe is to be led to a standard Rhodesia Railways choke valve, drawing 3/4294. The choke valves are to be situated in accessible positions. One oil pipe is to be led to the base of the steam pipe, and another to the top of the cylinder at mid position of stroke, as in the 16th Class engines, Order No.69.

Cylinders.

211. The cylinders are to be generally in accordance with drawing 114964, 17-1/2" diameter x 26" stroke, and are to be fitted with cast iron liners about 3/4" thick. The material is to be of the best close grained, strong, tough cast iron. The steam and exhaust ports are to be straight and of ample width.

212. Special attention is to be given to the fitting and bolting of the cylinders to the frames, to prevent any possible movement.

213. The cylinders are to be provided with cleaning doors, as shown on drawing 69/T.6403/53, and ~~ETB~~ 11/4" diameter ^{11 thread} ~~taper~~ plugs in covers and steam chest to permit the fitting of indicating equipment. as arranged on Drg 53/LS68.

Cylinder covers.

214. The cylinder covers should, if possible, be designed to suit right or left-hand cylinders until drilled for the lubricator pipe connections. The cylinder front covers are to be generally as shown on drawing 114964. The cylinder hind covers are to be arranged for LAIRD type double slide bars.

215. Each cylinder is to be fitted with a standard spring loaded pressure relief valve, drawing 6/9539/7228/132/L.817, Items A to G, and HENDRIE by-pass valve to drawing 6/9539/7228/131/L.817 except that grooves on the periphery of the valve are not required, and the travel is to be limited to 3/8". Suitable drainage is to be provided for the steam chests and cylinders.

216. Provision is to be made on all engines for the attachment of indicators.

Valve spindle and crosshead.

217. The valve spindle and crosshead are to be of the type shown on drawing 115076.

218. The crosshead is to be provided with separate slippers of Class A steel, case-hardened.

219. The crosshead guide is to be of cast steel with separate adjustable top and bottom cast iron slides.

220. The slides and slippers are to be lubricated by oil.

Piston valves and liners.

221. The piston valves are to be 9" in diameter, and generally follow the design shown on drawing 5415, the length of the barrel being arranged to suit the distance between steam edges.

222. The piston valve liners are to be similar in design to those shown on drawing 5322, with the provision of bridges at the top of the liners similar to those at the bottom. The steam chest hind covers should follow generally the design shown on drawing 114964, but with valve spindle glands and bushes of the 16th Class design.

223. The steam chest front covers are to have the arrangement of ~~elbow~~^{Bush} and gland shown on drawing 5042.

Attachment of cylinders to frame.

224. All the drilled holes in the frame and cylinder flanges are to be carefully reamed out and turned bolts must be driven in and secured by faced nuts. The holes are to be drilled to template.

Cylinder drain cocks.

225. The cylinder drain cocks are to follow the design on drawing 28/T.9470/60. The discharge orifices are to be fitted with copper pipes, clipped to the cow-catcher and arranged to blow forward.

Oil syphons and oil cups.

226. The locomotives are to be grease lubricated throughout, but where oil is required, such as to the piston rod, valve spindle, slide bars, etc., the lubrication is to follow the arrangement shown on drawing 114694 where possible, and the oil boxes are to be similar to those of the 16th Class engines.

Piston rods.

227. The piston rods are to follow the design shown on drawing 28/T.9470/109, with taper 1 in 4 at the head and 1 in 16 at the crosshead end. They are to be made from Class D steel, machined all over and finished by grinding.

Piston heads.

228. The piston heads are to be of cylinder quality cast iron and in accordance with the design shown on drawing 114964. Three narrow rings, 1/2" deep x 3/8" wide, are to be fitted to each head. The width of the gap in the rings when in position in the cylinder is to be 1/16". The gap is to be cut diagonally at 45°, and no dowels to register the position of the rings are required.

Metallic packing.

229. The piston rod stuffing boxes on two engines are to be fitted with United Kingdom metallic packing. The stuffing boxes of the other two engines are to be fitted with Paxton Mitchell metallic packing.

Expansion joints and steam pipes to hind engine

230. The expansion joints in the main steam and exhaust pipes to and from the cylinders are to be of the types shown on drawings 69/T.6403/84 and 85.

231. The steam and exhaust pipes between the smoke-box and hind engine are to run under the vee of the ashpan, as shown on drawing 69/T.6403/9.

232. The steam pipe is to be supported from the footplate casting by a U-clip.

233. The steam pipe is to be 5" internal diameter branching at the Y-pipe into two pipes each 4-1/2" internal diameter.

Slide bars.

234. The slide bars are to be of steel, and of the double bar LAIRD type, both bars being arranged above 114964 the piston rod, as on drawing 119464. The bars are to be bolted at the hind end to a cast steel bracket securely bolted to the frame and at the front end to a bracket cast solid with the cylinder hind cover.

235. Two lubricators, similar to those of the S.A.R. G.M. class engines, are to be provided to feed internally to each top slide bar.

236. The slide bar oil cup covers, where required, are to be in accordance with drawing 4303.

Crosshead and shoes.

237. The crosshead body is to be of cast steel, machined where required. The crosshead shoes are to be suitable for the LAIRD type double slide bars and provided with inserts of IBIS brand locomotive No.1 white metal, and felt pads at each end to keep the slide bars clean.

Gudgeon pins.

238. The gudgeon pins should be of Class D steel, double taper, as shown on drawing 114964, and arranged for grease lubrication.

Connecting rods.

239. The connecting rods should be similar to those shown on drawing 114694 and manufactured from Class C steel.

Connecting rod bushes.

240. The connecting rod small end bushes are to be of COG WHEEL brand Railway No.2 phosphor bronze, and suitable for grease lubrication. White metal linings are not required. The connecting rod big ends are to be arranged for grease lubrication with floating bushes. The design is to be similar to that shown on drawing 5399, with grease grooves as shown. The fixed bush is to be of Class D steel, and the floating bush of COG WHEEL Railway No.2 phosphor bronze. The fixed bush is to be secured by a set screw at the bottom and a screwed nipple at the top.

Coupling rods.

241. The coupling rods are to be of the design shown on drawing 114964 and manufactured from Class C steel.

Coupling rod bushes.

242. The coupling rods are to be arranged for grease lubrication with floating bushes as shown on drawing 5399, with grease grooves as indicated. The fixed bushes are to be of Class D steel, and the floating bushes of COG

SHREL brand Railway No.2 phosphor bronze. White metal linings are not required. The fixed bushes are to be secured by means of a set screw at the bottom and a screwed nipple at the top as shown on drawing 5399.

Lubrication of connecting and coupling rods.

243. The crank pin bearings for the connecting rod big ends and coupling rods are to be lubricated by means of AJAX grease nipples of suitable size for grease lubrication.

244. The connecting rod small end bushes are to be lubricated by means of an AJAX grease nipple fitted to the end of the gudgeon pin and grease passages provided through the gudgeon pin to the bearing surface.

Coupling rod knuckle pins and bushes.

245. The knuckle pins are to be of the type shown on drawing 69/T.6403/59, and arranged for grease lubrication. The knuckle pin bushes are to be of 000 SHREL brand Railway No.2 phosphor bronze.

Crank pins.

246. The crank pins, washers and nuts are to be of Class B steel and of the design shown on drawing 114964. A similar arrangement of washer and crank pin is to be used for both the outer and inner coupled wheels, if by so doing the inner and outer coupled wheels and axles complete can be made interchangeable.

Valve motion.

247. The valve gear must provide efficient admission rates from 75 % to 25 % cut offs, and the travel arranged to suit, and be proportioned so as to admit or release the steam as equally as possible for both strokes and for all ratios of expansion. Particular attention must be given to the design of the valve motion to ensure the best possible performance, having regard to the conditions of service defined in Clause 124, and permit the engine to run freely at speed with 25 % cut off, and without causing the connecting rod big ends to overheat.

248. The valve motion is to be of the WALSCHAERT type on drawing 114964, controlled by steam reversing gear. The motion pin holes are to be fitted with bushes

of GGG WHEEL brand Railway No.2 phosphor bronze and arranged for grease lubrication by AJAX nipples. The motion pins are to be of Class A steel, case-hardened and, where possible, all pins are to be 1-3/4" diameter. The taper pins are to be similar to those used on the 16th Class locomotives, Order 69.

249. The lifting link is to operate at the rear of the reversing link, as shown on drawing 114694.

250. Each eccentric crank pin is to be provided with a SKEFKO roller bearing, lubricated by grease. Quadrant block in the reversing link to be made of phosphor bronze.
Steam reversing gear.

251. The steam reversing gear is to be arranged as shown on drawings 28/T.9470/114 and 115. Steam and cataract cylinders, to the modification on drawing 4213, are to be fitted if possible.

252. The operating and indicating levers are to be fitted on the right-hand side of the cab. The carrying bracket is to be supported on the cab side plate. The steam supply is to be taken from the right-hand steam turret.

253. The index plate of the steam reversing gear is to be marked in percentages of stroke at which steam is cut off, and a pointer provided on the reversing gear handle indicating the actual cut off. The graduation of the index plate must be correct when the engine is in steam.

254. The motion arrangement drawing is to show a table of the steam distribution for forward and backward gears as well as all other information relating to the motion.

Cowcatcher.

255. A cowcatcher to drawing 69/T.6403/51 is to be fitted at both ends of the engine and arranged so that two engines can be coupled together.

Bearing springs.

256. All bearing springs are to comply with the Consulting Engineers' Standard Specification 3.16 (June, 1936) and are to be designed so as to cope efficiently with the loads to which they will be subjected. The method of fixing the spring buckle is to be in accordance with the

Rhodesia Railways standard practice, and the coupled wheel springs, gibs, and cotters are to conform, if practicable, to drawing 28/T.9470/138.

Wheels, tires and axles

257. The journals of the outer coupled, driving and inner coupled axles are to be 8" diameter x 9" long.

258. The journals of the bogie axles are to be about 6-1/4" diameter to suit SKKFKO roller bearings.

259. The wheel centres are to be of cast steel.

260. Each wheel centre is to be pressed on its axle by hydraulic pressure of not less than 10 or more than 14 tons per inch of axle diameter.

261. All tires are to be of Class B steel, oil-hardened and tempered.

262. The profile of the tires of the driving wheels is to be as Item D, drawing 69/T.6403/61, and the profile of all other tires is to be as shown on drawing A.36734C. All tires are to be shrunk on to the wheel centres and secured by Gibson rings to drawing S.O.31. All tires are to have a "limit of wear" groove turned in the outside face to indicate the scrapping thickness, which is 1-1/2" for tires of coupled wheels and 1-3/8" for bogie tires.

263. All tires are to be marked in accordance with Drawing A.36734C, the identification letters being T for coupled wheel tires, and P for bogie wheel tires.

Balancing.

264. The whole of the revolving, and approximately 40% of the reciprocating, weights are to be balanced. A hammer blow of 1.5 tons on any one wheel at 50 miles per hour must not be exceeded. Particular care is to be taken to obtain accurate balancing, and the wheels are to be tested to check the balance weights with the calculations. Full calculations of the balancing are to be submitted to the Consulting Engineers. In order to ensure that the maximum pressure on the rails, due to the hammer blow of the weights provided for reciprocating balance, is equal for all coupled wheels, cross-balancing by the setting of the centres of gravity of the balance weights to one side of a position directly opposite the crank pins may be resorted to if necessary. Balancing diagram to be included in the "As made" drawings.

Frames, platforms, footsteps, etc.

265. The main frames are to be of the bar type, similar to those of the Sudan Garratt locomotives, drawing 114964, except that the horn-gaps should be altered to take the standard axleboxes to drawing 69/T.6403/62 and wedges, guides and keeps to drawing 69/T.6403/65. Also the pivot centres are to be of the inverted type with wedge adjustment.

266. Suitable fittings are to be provided to facilitate lifting the boiler unit off the engine units.

267. The frames are to be machined all over on both sides and special care taken that all fitting surfaces are accurately machined, particularly at the hornstays, which must be fitted so as to prevent any spring in the frames at these points.

268. All permanent bolts not provided with split pins are to have the end threads knocked over with a 3-pronged punch.

269. The frames are to be of ample strength and effectively cross-stayed. When the frames, cross stretchers and buffer beams are bolted together and riveted up the accuracy of the work is to be tested by diagonal, longitudinal and transverse measurements.

270. The wedges and guides for the coupled wheels are to be secured to the frames by bolts, to prevent any movement which would cause wear on the frame and also prevent them from falling when the axleboxes are removed.

271. Each frame unit is to be provided with four lifting brackets, one at each corner, as on the 16th Class engines.

272. Footsteps are to be provided at the front and hind ends of the engine, with suitable hand rails on tank ends. Footsteps and hand rails for access to the cab are to be identical with those of the Sudan Garratt locomotives.

273. The platforms, the upper surfaces of which are to be chequered, are to be arranged to run the full length of the boiler frame, and are to be constructed of steel plate $\frac{3}{16}$ " or $\frac{1}{4}$ " thick.

274. A ladder is to be provided on the left-hand side of the boiler to give access to the feed heater and blower steam stop valve.

Axleboxes.

275. The coupled wheel axleboxes are to be of COG WHEEL brand Railway No.2 phosphor bronze, and arranged for grease lubrication. The keeps, AJAX grease lubricators, etc. are to be in accordance with Whitelegg & Rogers' drawing P.2923/IR, except that the keeps are to be fitted with phosphor bronze liners on the sides adjacent to the wheel hubs.

276. The inside faces of the wheel hubs are to be grease lubricated and grease grooves in the faces are required. The horn cheek faces are to be lubricated by oil from cavities in the tops of the axleboxes.

277. A felt pad is to be fitted to the top edges of each axlebox to assist in excluding dust and dirt from the horn cheeks.

Spring rigging.

278. The springs of the coupled wheels and inner bogie wheels are to be compensated and arrangements made for the compensation to be:-

- a) in one group,
- b) in two groups with division between the driving and inner coupled wheels.

Two engines are to be shipped with arrangement (a) and two with arrangement (b), and the necessary parts are to be supplied to enable all engines to be compensated by either arrangement as may be found the more satisfactory in service.

279. The compensating beams throughout are to be fitted with pins, but the compensating beam brackets between coupled wheels are to be fitted with SKFEMO roller bearings.

280. Ample bearing surface at the ends of the compensating beams is to be provided and the bosses are to be solid with the beams and not welded on.

281. Ample clearance is to be allowed between the spring links and frame.

282. The spring gear pins are to be of Class A steel, case-hardened and lubricated by means of AJAX nipples.

283. Where simple pin bearings are provided, the pin holes are to be bushed with hard phosphor bronze and peripheral grooves machined in the pins to distribute grease.

Brake.

284. One steam brake cylinder is to be fitted to each engine unit, similar to the arrangement on the Sudan Garratt locomotives. The brake gear is to be arranged so that the brake blocks are applied to all coupled wheels. The brake gear, brake blocks, brake pins and method of adjustment are to be standard with the 16th Class locomotives where possible. The brake gear is to be grease lubricated by AJAX nipples.

285. The vacuum train pipe is to terminate at each end of the engine in two hose connections, as on the 16th Class locomotives.

Buffing and drawgear.

286. An ATLAS No.2 top-operated cast steel automatic coupler with 7" x 5" shank and horizontal key is to be fitted at each end of the engine.

287. Spencer Moulton spring draft gear, consisting of three nests of rectangular rubber springs, is to be provided.

288. Provision for emergency drawgear is not required.

Bogies.

289. The bogies are to be of the Sudan Garratt type and fitted with SKFKO roller bearings.

290. Manganese steel liners are to be fitted to the horn blocks and horn faces of the roller bearing axleboxes and no lubrication for the liner bearing surfaces is required.

291. The bogie control springs are to be of the back to back type.

292. The bogie swing links are to be bushed with hard phosphor bronze, and the bogie centre liners are to be of the same material. The bogie swing link pipes are to be of Class A steel and case-hardened.

293. Grease lubrication is to be provided for all working parts by means of AJAX nipples and flexible tubes. The nipples are to be grouped on a bracket or stand placed in an accessible position. Auxiliary oil lubrication is also to be provided for the bogie centres.

Cab.

294. The cab is to be generally in accordance with the 16th Class design with open end, subject to the following modifications:-

- a) The cab is to be of welded construction and not riveted.
- b) Any rivets necessary in the cab plates are to have snap heads outside and small heads inside, and not countersunk.
- c) The driver's and fireman's seats and kit boxes are to be similar to those of the 16th Class engines, Order 69. Special attention is to be given to making both boxes watertight, to prevent the ingress of water during boiler washout operations.
- d) A standard wagon card and invoice fastener to drawing 3212 is to be fixed to the roof lining boards above the side window, on the driver's side.
- e) The whistle cords are to be arranged for operation by both driver and fireman.
- f) Arm rests of Rhodesia Railways standard design are to be provided.
- g) A fire guard to protect the driver from the heat of the fire is to be fitted to the right-hand side of the firehole door, as on the Sudan Garratt locomotives.
- h) The cab floor is to be made in small sections for easy removal, similar to that of the 16th Class engines, Order 69.
- i) The cab front doors are to be in accordance with Drawing 5306.
- j) A small rectangular draught shield window is to be attached to rear end of the front section of each side sliding window. The draught shield window is to consist of a brass frame protecting all edges of the plate glass and is to be capable of being secured in any position between flat against the cab and at right angles to it.

Cab fittings.

295. All cab fittings, hinges, etc. are to be of gunmetal.

Number plates.

296. Number plates to the design shown on drawing 28/T.9470/179 are to be fixed, one on each side of the cab.

Speed indicator.

297. A Stone-Deuta electrical speed indicator, calibrated from 0 to 60 M.P.H., is to be fitted to each engine.

298. The drive is to be of the flexible torsionless wire type.

299. Ten instruction books describing construction, operation and maintenance of the speed indicators are to be supplied.

Sanding apparatus.

300. Four sand boxes are to be provided, one in front of each outer coupled wheel on each unit.

301. The sand boxes may be constructed of 1/8" steel plates welded together if less expensive than cast iron. Pressed steel lids, hinged at the back and secured at the front by eyebolts, hasps and wing nuts, are to be fitted. A hand hole is to be provided in a suitable position in the lower portion of each sand box for inspection purposes, and it is to be efficiently covered by a steel plate studded to the box. A stiffening ring is to be provided, inside the sand box round the hole, to accommodate the studs.

302. Lambert hot water sanders are to be provided.

303. The front and hind pairs of sand boxes are to be arranged for independent operation, one sand valve being used for the front and another for the hind pair of sand boxes. Both sand valves are to be situated on the driver's side of the footplate.

Clothing.

304. The boiler is to be clothed with asbestos mattresses fitted with stools.

305. The mattresses are to be in accordance with the Consulting Engineers' Standard Specification S.17 (November 1932) and of J.W. Roberts, Ltd.'s manufacture.

306. The clothing plates are to be of polished steel and the joints covered with hoops of stainless steel 3" wide.

307. The firebox sides, above the platform, are to be lagged and clothed. The lagging and clothing round the firebox is to be made in sections on each side, as on the 16th Class locomotives, in order that they may be removable without disturbing other sections or dismantling the cab.

308 The cylinders and steam chests are to be lagged and clothed with the same materials as the boiler.

309 Stainless steel cover plates are to be fitted to the covers of the cylinders and steam chests.

Hand-railing.

310. The hand-rails along the side of the boiler, across the smokebox door, on the cab, at each end of the engine and elsewhere as required, are to be of stainless steel tubing, polished, and where necessary fixed in steel pillars.

311. The seatings for the pillars on the boiler are to be attached by means of studs to the boiler barrel, and to the firebox sides.

312. The pillars on the smokebox wrapper plate are to be in one piece and secured to the wrapper plate by open ended steel nuts inside the smokebox.

313. The seatings on the boiler barrel and firebox are to pass through the lagging and the pillars secured to the seatings by taper pins passing through both seating and pillar.

Electric head lamps.

314. J. Stone & Co.'s L.B.B. turbo headlight and cab lighting equipment 300/350 watts 32 volts with TONUM R headlight projector and generator is to be provided.

315. The electric light switches are to be located on the driver's side of the cab.

316. A wooden container for carrying spare lamps is to be provided in a convenient position inside the cab.

317. The turbo generator is to be placed on a mounting fixed to the platform on the left-hand side of the boiler.

318. The exhaust steam pipe is to be led back towards the cab and then vertical to exhaust over the cab roof on the left-hand side of the longitudinal centre line.

319. Lights in the cab are to be provided to illuminate the water gauge glasses, gauges, lubricators, reversing gear indicator and speed indicator. Also three in the cab roof, one each above the driver's and fireman's seats and one midway between.

Oil lighting.

320. Two portable oil burning tail lamps with red shades are to be supplied with each engine, and two water gauge lamps of the oil burning type are to be fixed on brackets in suitable positions for use in event of failure of the electric lights.

321. One lamp bracket is to be fitted at each end of the engine on the tanks for the oil burning tail lamps as on the 16th Class locomotives.

Coal space.

322. The coal space at the front of the hind unit is to be arranged to accommodate 10 tons of coal. The sides of the coal space are to be suitably reinforced with angles and gussets.

Water space.

323. The water space is to be sufficient to accommodate approximately 4,300 gallons in the front unit and 2,700 gallons in the hind unit, and is to be well provided with baffle plates which may be welded to the angles.

324. Suitable holes are to be provided in the baffle plates to allow access to any part of the tanks for inspection and repair.

325. The tanks are to be supported on saddles and all joints in the bottom plates of the water and coal spaces are to be welded. The tees and angles are to be attached to these plates by welding.

326. The tank bottom plates are to be rolled to a 6" radius at the sides, and the joints with the side plates are to be above this radius. All rivets are to be snap headed.

327. The tanks are to be tested to ensure that they are watertight.

328. The tank filling holes and lids are to accord with drawings 69/T.6403/69 and 28/T.9470/149 respectively.

329. Strainers are to be provided inside the tank filling holes.

330. Suitable drains are to be arranged for draining water from the tank tops.

331. The tanks are to be provided with air vent pipes, hand rails and brackets, fire iron supports, etc.

332. One water level test gauge is to be provided on the fireman's side of the cab.

333. Lifting brackets and shackles are to be fitted to the tanks, as on the Sudan Garratt locomotives.

Coal watering.

334. A coal watering cock is to be fitted on the fireman's side of the cab with 1/2" internal diameter hose pipe.

Steam heating

335. The locomotive is to be equipped with South African Railways standard steam heating apparatus so arranged that it can be coupled up at either end of the locomotive.

Tools.

336. Instead of the two 35-ton telescopic and traversing screw jacks called for in Clause 98, four Luff-Horton ball bearing screw jacks, of 40-ton lifting capacity each, are to be supplied, and fixed two on the front and two on the hind platforms.

337. All tools are to be of the Railway Company's standard types and stamped with the letters "R.R." and the number of the engine to which they belong. All padlocks are to be similarly stamped.

338. Hammer shafts, etc. are to be of suitable length so that they can be stored in the toolbox.

Bolts and nuts.

339. All bolts, screws and nuts, except where otherwise specified, are to be made to Whitworth standards and screwed parallel, not tapered.

Screwing.

340. All screw threads, unless specified to the contrary, are to be in accordance with Whitworth Standards.

341. Studs where screwed into the boiler shell and projecting into the steam or water spaces, are to be screwed as follows:-

Under 7/8" dia. - Number of threads as per Whitworth Standard.
7/8" dia. & over - 11 threads per inch.

342. For brass work, boiler stays and washout plugs the screwing is to be as follows:-

Brasswork.

7/8" dia. and under	1 1/4	threads	per	inch.
Over 7/8" dia.	11	"	"	"
<u>Boiler stays</u>	11	"	"	"
<u>Washout plugs</u>	11	"	"	"

Clearances.

343. There must be ample clearance everywhere to allow of the engine negotiating curves of 275 ft. radius with a super elevation of 4-1/4" and with a widening of the gauge of not more than 3/4".

Accessories.

344. Each engine is to be supplied with a full set of grease guns arranged in a suitable case.

345. One complete set of axlebox grease blocks and a supply of grease sticks for motion parts is to be supplied with each engine.

346. All axleboxes and grease lubricated parts are to be filled with grease before shipment.

Boiler tests.

347. The boiler is to be tested as prescribed in Clause 100.

348. All studs and fittings must be in place when the boiler is tested, and all faced joints made with boiled linseed oil only.

349. Triplicate copies of the Test Certificate, signed by the Contractors' representative and the Engineers' Inspector, are to be supplied to the Consulting Engineers.

350. A brass plate bearing the test pressures, working pressure, date and type of tests, are to be fixed on the back plate of the boiler.

Engine weights and weighing.

351. The first locomotive erected is to be weighed empty and then in working order as prescribed in Clause 125.

352. The distribution of weight, both empty and in working order, on each pair of wheels must be accurately

ascertained and recorded on the locomotive diagram and general arrangement drawings. The height of the centre of gravity above rail level, both empty and in working order, is also to be recorded on the diagram and general arrangement drawings.

353. Should the Contractor desire to depart from the weights specified in Clause 126 reference must first be made to the Consulting Engineers.

Painting.

354. No part of the engine shall receive any paint whatever until every surface has been scraped perfectly clean and every trace of rust removed.

355. The boiler shell is to have two coats of Dampneys' APREXION compound applied internally before the firebox is riveted.

356. After satisfactory steam test and while hot the boiler is to receive externally one coat of boiled linseed oil, followed when cold by one coat of red lead oxide.

357. One coat of grey coloured lead base paint is to be applied to the cab, frames, wheels and tanks.

358. The interior of the water tanks is to receive two coats of Wailles-Dove BITMO solution, which must be allowed to dry thoroughly before water is put into the tanks.

359. The smokebox and chimney are to be painted with a smokebox black paint of approved make.

360. All brake and spring gear is to be painted with one coat of black japan enamel.

361. The springs are to be given one coat of oil and not painted.

362. No paint is to be applied to the planished steel clothing plates.

363. The final painting will be undertaken on arrival of the engines in Rhodesia.

364. All bright parts of the engine are to be thickly covered with vaseline or petroleum jelly to prevent rusting during shipment.

Shipment.

365. The engines are to be shipped as follows:-

- 1) Engine frames with wheels, axles, frame castings, cylinders, motion, front and hind bogies in position, completely assembled, ready for hauling on their own wheels to the place of assembly.

The coupling rods should be left in place, connecting rods and eccentric rods removed and the pistons firmly secured at the outer end of the cylinders.

Temporary distance collars are to be fitted to the big end journals of the driving crank pins to keep the coupling rods in position.

- 2) Boiler, complete with lagging, cab, and all mountings, fixed in the boiler frame, ready for mounting on the engine units.
- 3) The remaining details packed in strong wooden cases, battened and hooped.

As-made drawings.

366. Four complete sets of as-made drawings (one original on tracing cloth and ²three copies on GEMIN B.S.S. transparent linen with black lines) are to be supplied to the Engineers on the completion of the order.

367. The hand-made tracings are to be forwarded to the Consulting Engineers for examination before the copies are made.

368. On each detail drawing a neat tabular list is to be given, showing:-

- 1) Index letters,
- 2) Names of articles,
- 3) quantity required for each locomotive.
- 4) Material from which made
5. B.S.S. class of material.
- 6) Class of finish and whether case-hardened, heat-treated, etc.,
- 7) Weight of each finished detail per engine.

369. In reference to engine numbers on the as-made drawings, the Railway Company's serial number must be quoted and not the Contractors' progressive number.

370. Drawings of proprietary fittings are to show the name of the actual maker and the size, capacity and distinctive name by which the fitting is known.

371. The titles are to be placed in the bottom right-hand corner in accordance with the arrangement employed in the drawings for the 16th Class locomotives, Order 69.

372. Each set of drawings is to measure 40" x 27", and is to be complete with strong japanned tin case with hinged lid.

373. The name of the Railway, class of locomotive, name of makers, date and number of order are to be painted in white on the side of the case and on the lid. The marking on the lid is to accord with the arrangement shown in the lower diagram on drawing B.37841.

374. The as-made drawings should, if possible, be ready for shipment at the same time as the locomotives. If, however, this is not practicable, a complete set of erection prints, including copies of the Contractor's shop drawings of essential details, are to be shipped with the first locomotive.

Photographs.

375. Eight sets of photographs are to be supplied, each set comprising:-

- Side view, right-hand side of locomotive.
- Side view, left-hand side of locomotive.
- View of front of front unit.
- View of back of front unit.
- View of front of hind unit.
- View of back of hind unit.
- View of top of one engine unit with tank removed.
- View showing the mountings on the firebox back plate inside the cab, with cab roof removed.

All photographs are to show full views and not oblique ones.

376. Two sets of photographs are to be mounted collectively on sheets of linen-backed drawing paper of the same size as the as-made tracings, one set included in the hand-made tracings and the other in one set of OQUALID copies. Three sets are to be mounted, each photograph separately, on cardboard mountings suitable for framing, and the remaining three sets are to be unmounted.

377. The side views of the locomotive are to be 18" x 11" field in seven sets, and 14" x 11" field in the remaining set, which is to be unmounted. All photographs of the other views are to be 14" x 11" field.

Materials.

378. All materials, workmanship and finish used throughout the construction of the locomotives must comply with the requirements of the Consulting Engineers' General Specification for Engines & Tenders, 1925, and the appropriate British Standard Specifications and Tests referred to therein except as herein modified.

Marking.

379. All parts are to be conspicuously marked with the Company's initials "R.R" (NOT "R.R.M") in addition to the Company's serial number of the engine to which they belong.

Packing

380. Wherever necessary, parts are to be properly protected and suitably packed so as to preclude all risk of injury during export shipment.

Slings marks.

381. Correct slinging marks are to be painted on all heavy packing cases.

Sub-contractors.

382. The names of all sub-contractors are to be submitted to the Engineers for approval, and triplicate copies of all sub-orders are to be sent to the Engineers. Sub-orders for details which are to be manufactured to the Contractors' drawings are not to be issued to sub-contractors until the drawings have been first approved by the Engineers.

383. Materials are not to be despatched to the Contractors' works from sub-contractors' works until they have been inspected and passed by the Engineers.
